

(19)



Europäisches Patentamt

European Patent Office

Office européen des brevets



(11)

EP 0 962 660 A1

(12)

## EUROPEAN PATENT APPLICATION

(43) Date of publication:

08.12.1999 Bulletin 1999/49

(51) Int. Cl.<sup>6</sup>: F04D 29/66, H02K 15/16,  
F16F 15/32

(21) Application number: 99830222.8

(22) Date of filing: 16.04.1999

(84) Designated Contracting States:  
 AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU  
 MC NL PT SE  
 Designated Extension States:  
 AL LT LV MK RO SI

(30) Priority: 05.06.1998 IT TO980490

(71) Applicant:  
 MAGNETI MARELLI CLIMATIZZAZIONE S.p.A.  
 10046 Poirino (Torino) (IT)

(72) Inventor: Pugliese, Vincenzo  
 10046 Poirino, Torino (IT)

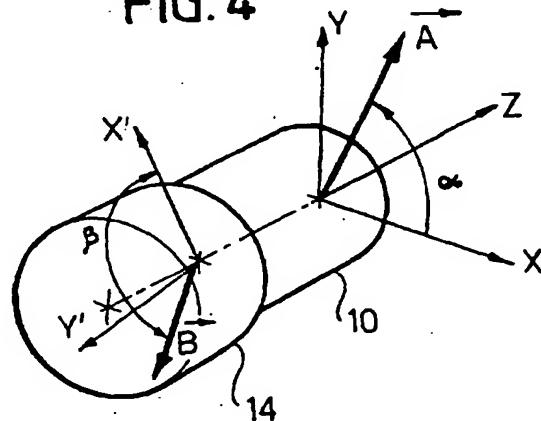
(74) Representative:  
 Marchitelli, Mauro  
 Buzzi, Notaro & Antonielli d'Oulx Srl,  
 Corso Fiume 6  
 10133 Torino (IT)

## (54) A method for assembling an electric fan

(57) A method for assembling an electric fan including a fan (14) connected to the rotor (10) of an electric motor, comprising the steps of:

- determining the orientation of the unbalance vectors both of the fan and of the rotor, and
- mounting the fan (14) and the rotor (10) so that the respective unbalance vectors are in a phase opposition to each other.

FIG. 4



## Description

[0001] The present invention relates to a method for assembling an electric fan.

[0002] The invention has been developed with particular reference to electric fans for heating, air-conditioning and engine cooling units for vehicles, including a plastics material or aluminium fan coaxial with the rotor of an electric motor. The fan and the rotor are mechanically connected to each other in various ways (screwing, fitting with interference and the like). Each of these two members, separately, is statically unbalanced of a certain quantity, which can be measured in general as:

$$S = MExd$$

where:

ME = eccentric mass, and

d = distance from the axis of rotation.

[0003] The rotor-fan unit after assembly is in its turn unbalanced of a total quantity equal to the vectorial sum of the two initial unbalance.

[0004] In order to reduce the total unbalance to acceptable values, in the known assembly methods the step of connecting the fan to the rotor is followed by a step of controlling the residual unbalance and, if the total unbalance is higher than a predetermined value, by a balancing step. Such balancing requires the application of weights with suitable mass in suitable positions, so that the unbalance of the rotating member is brought below a prescribed limit. This operation requires a time that has a significant influence on the assembly cost.

[0005] The present invention has the object to provide a method for assembling an electric fan which is not affected by said drawback.

[0006] According to the invention, this object is achieved by a method having the features forming the subject of the main claim.

[0007] The method according to the invention consists essentially in assembling the fan and the rotor of the electric motor with opposed unbalance vectors. In this way, the total unbalance is equal to the arithmetical difference of the initial unbalances of the two components. The total unbalance of the fan-rotor unit in the great majority of cases will be smaller than the prescribed limit which requires a separate balancing operation. In this way it is possible either to reduce considerably or to totally nullify the time required for balancing the electric fans.

[0008] Further characteristics and advantages of the present invention will become clear in the course of the detailed description which follows, given purely by way of non-limiting example, with reference to the annexed drawings, in which:

- figure 1 is a schematic lateral view of a rotor-fan unit,
- figures 2 and 3 schematically show the rotor and the fan with the respective static unbalance vectors, and
- figure 4 is a perspective view which schematically shows the rotor and the fan mounted with the respective static unbalance vectors in phase opposition.

[0009] With reference to the drawings, 10 indicates the rotor of an electric motor, having a shaft 12 on which a fan 14 is fixed by means of any known connection system. Both the rotor 10 and the fan 14 have static unbalances which in figure 1 are schematically represented by eccentric masses respectively indicated 16 and 18. This representation is purely fictitious because usually the static unbalances are not formed by a concentrated mass, but rather by an asymmetric distribution of the total mass with respect to the axis of rotation. However, the end effect of the static unbalance of a rotating member can be represented by a concentrated eccentric mass.

[0010] With reference to figures 2 and 3, the static unbalance of rotor 10 and fan 14 are represented by two vectors A and B each of which has an amplitude proportional to the product of the concentrated eccentric mass by its distance from the axis of rotation. Each vector representing the unbalance has furthermore a characteristics phase angle indicated respectively by  $\alpha$  and  $\beta$  which locates the positions of the unbalance vector with respect to a coordinate system X, Y and X', Y'.

[0011] In accordance with the method according to the present invention, the fan 14 is rotated about its own axis in order to determine the orientation  $\beta$  of its unbalance vector B. This position is marked for a subsequent use in the assembly line or the fan is positioned such that the orientation of the unbalance vector is known.

[0012] During the preparation of the rotor 10 or in the subsequent testing of the motor without the fan, the rotor is mechanically rotated, so as to determine the orientation  $\alpha$  of the unbalance vector A. This position is marked for a subsequent use on the assembly line or the motor is positioned so that the orientation of the unbalance vector is known.

[0013] The final connection of the fan 14 on the rotor 10 is made so as to oppose the two unbalance vectors A and B, as schematically shown in figure 4. In the condition in which  $\alpha = \beta - 180^\circ$ , the total static unbalance of the rotor-fan unit has an amplitude given by the difference between the absolute values of the unbalance vectors A and B.

[0014] In this way, in a mass production the number of balancing operations necessary for bringing the total unbalance below a predetermined level will be considerably reduced. The balancing will be requested only in the few cases in which the arithmetic difference between the two static unbalance remains greater than

the predetermined threshold value.

#### Claims

1. A method for assembling an electric fan including a fan (14) connected to the rotor (10) of an electric motor, characterized in that it comprises the steps of:
  - determining the orientation of the unbalance vectors (A, B) both of the fan (14) and of the rotor (10), and
  - mounting the fan (14) and the rotor (10) so that the respective unbalance vectors (A, B) are in a phase opposition to each other.
2. A method according to claim 1, characterized in that the rotor and the fan are marked for indicating the positions of the unbalance vectors and are assembled to each other with the respective markings in diametrically opposed positions.
3. A method according to claim 1, characterized in that the fan and the rotor are moved positioned so that the orientations of the respective unbalance vectors is known and are assembled so as to place in diametrically opposed positions the known locations of the respective unbalance vectors.

30

35

40

45

50

55

FIG. 3

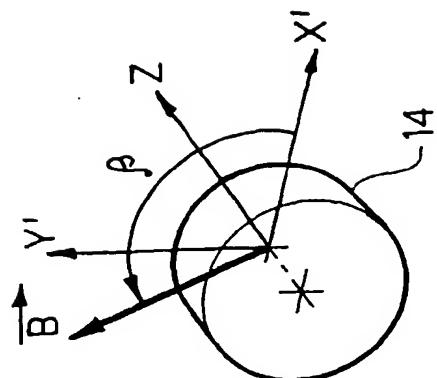


FIG. 2

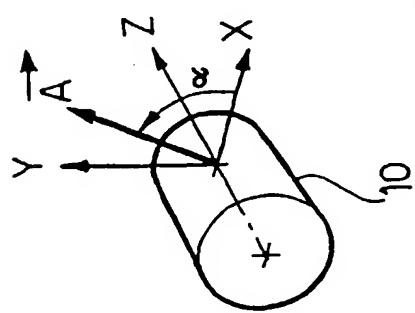


FIG. 4

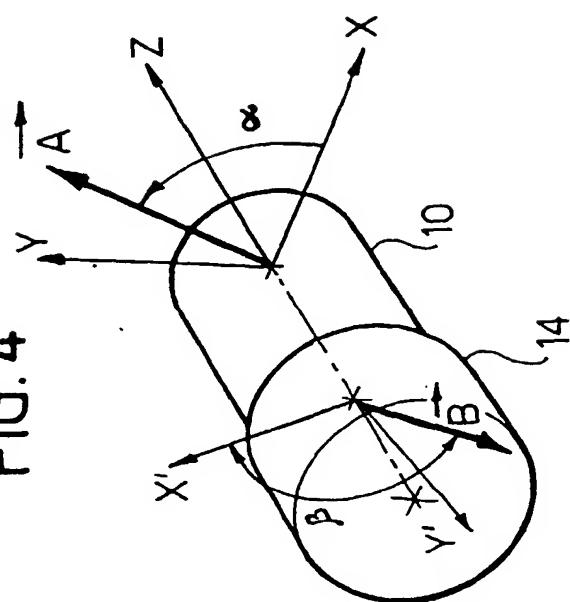
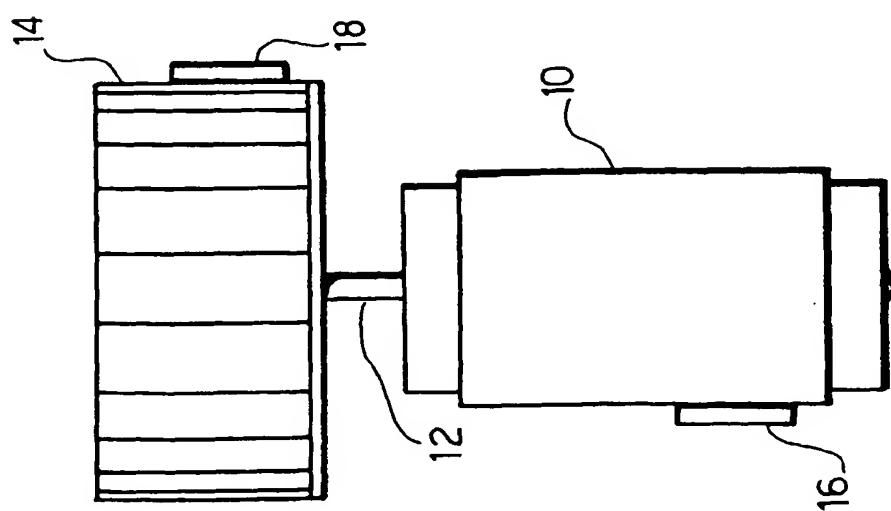


FIG. 1





European Patent  
Office

## EUROPEAN SEARCH REPORT

Application Number  
EP 99 83 0222

DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int.Cl.6)						
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim							
X	PATENT ABSTRACTS OF JAPAN vol. 9, no. 286 (M-429), 13 November 1985 (1985-11-13) & JP 60 125800 A (MATSUSHITA DENKI SANGYO), 5 July 1985 (1985-07-05) * abstract *	1-3	F04D29/66 H02K15/16 F16F15/32						
A	DE 195 01 959 A (ROBERT BOSCH) 25 July 1996 (1996-07-25) * column 4, line 8 - column 5, line 57; figure 3 *	1-3							
A	FR 1 367 106 A (SCHENCK) 20 November 1964 (1964-11-20). -----								
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)						
			F04D H02K F16F						
<p>The present search report has been drawn up for all claims</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 33%;">Place of search</td> <td style="width: 33%;">Date of completion of the search</td> <td style="width: 34%;">Examiner</td> </tr> <tr> <td>THE HAGUE</td> <td>6 September 1999</td> <td>Teerling, J</td> </tr> </table>				Place of search	Date of completion of the search	Examiner	THE HAGUE	6 September 1999	Teerling, J
Place of search	Date of completion of the search	Examiner							
THE HAGUE	6 September 1999	Teerling, J							
<p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p> <p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons &amp; : member of the same patent family, corresponding document</p>									

ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.

EP 99 83 0222

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.  
The members are as contained in the European Patent Office EDP file on  
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

06-09-1999

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
JP 60125800	A	05-07-1985	NONE		
DE 19501959	A	25-07-1996	FR	2729801 A	26-07-1996
			IT	1281694 B	26-02-1998
			JP	8240504 A	17-09-1996
			US	5738503 A	14-04-1998
FR 1367106	A	20-11-1964	DE	1266018 B	
			GB	1041719 A	